PESTS NOT KNOWN TO OCCUR IN THE UNITED STATES OR OF LIMITED DISTRIBUTION, NO. 25: EGYPTIAN COTTONWORM

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Order: Family — Lepidoptera: Noctuidae

Pest — EGYPTIAN COTTONWORM
Spodoptera littoralis (Boisduval)

Selected Synonym — Long identified as: *Prodenia litura* Fabricius

Economic Importance — This pest feeds on many economic crops causing a variety of damage as a leaf feeder and sometimes as a cutworm on seedlings. In 1938, it caused a loss of one-half million bales of cotton in Egypt. Losses have been as high as 75 percent. While principally the leaves are attacked; flower buds and green bolls may also be damaged sometimes leaving only the bare stalks. It is a major pest of beets in Israel and alfalfa in Libya (Gentry 1965). In Israel, the pest causes very serious damage. Clover fields have often been completely devastated a few days after the seeds have germinated.

Danger of damage to vegetable crops and nurseries is greatest during the summer. The larvae, especially the larger ones, gnaw large holes in the leaves and sometimes even destroy fruit such as tomatoes and peppers. Heavy attack on young plants retards their development, and plants produce only a few or late fruit. The larvae cause serious economic damage to medicinal plants where all parts of the leaves are important for the extraction of the desired essence.

In the vineyard larvae gnaw large holes in leaves until sometimes only the veins remain. The damage caused by larvae to grapevines is not merely temporary; vines may suffer so severely from exposure to intense sunlight during the summer that their development in the following year will be retarded. Larvae also gnaw at grapebunch stalks which, as a result, dry up, and the larvae then feed on the grape berries.

In the summer the larvae may also be found in deciduous orchards causing heavy damage to trees by extensive feeding on leaves, with at times only the leaf veins left untouched. The terminal growing points are also damaged.

Injury is greater to young orchards than to established ones, but even in the latter losses may be considerable, especially when fruit is attacked. Apples begin to rot immediately; young plants may suffer complete defoliation and many may even die.

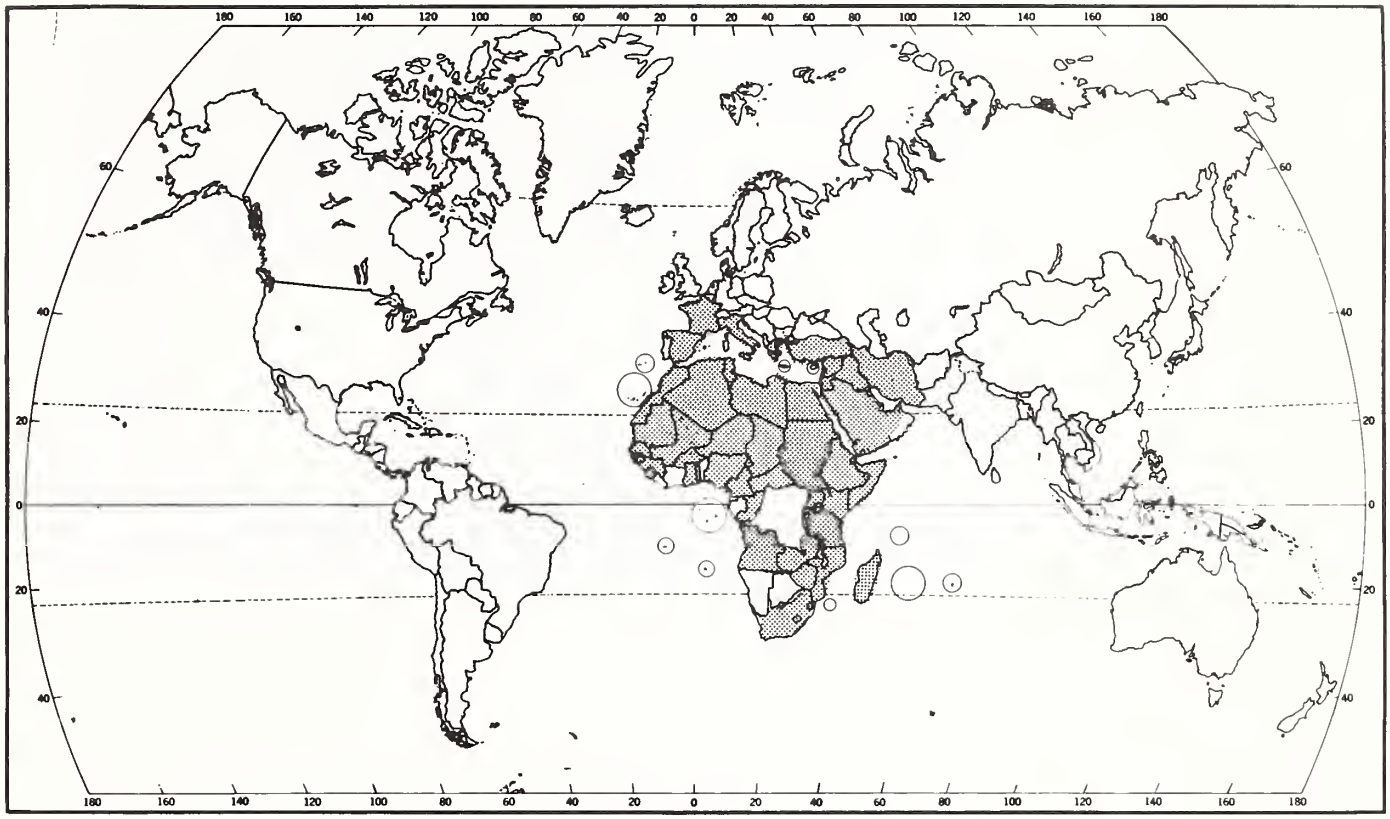
Occasionally in summer months, wandering regiments of larvae from a recently cut fodder plot may attempt to reach adjacent fodder plots, vegetable fields, or other farm crops. On sown pasture land larvae prefer leguminous plants to gramineous ones (Avidov 1969).

General Distribution

Aldabra Islands, Algeria, Angola, Ascension Island, Bahrain Island, Burundi, Cameroon, Canary Islands, Central African Republic, Chad, Comores Islands, Congo, Cyprus, Dodecanese Islands, Egypt, Eritrea, Ethiopia, France, Fernando Poo, Gambia, Ghana, Greece, Guinea, Iran, Iraq, Israel, Italy, Jordan, Kenya, Lebanon, Libya, Madagascar, Madeira, Majorca, Malawi, Mali, Malta, Mauritania, Mauritius, Morocco, Mozambique, Niger, Nigeria, Principe, Reunion, Rodriguez, Rwanda, St. Helena, Sao Tome, Saudi Arabia, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Spain, Sudan, Syria, Tanzania, Togo, Tunisia, Turkey, Uganda, Upper Volta, Yemen, Zambia, and Zimbabwe (Commonwealth Institute of Entomology 1967).

Hosts

This insect is a general feeder on crucifers, deciduous fruit trees, grasses, legumes, medicinal crops, ornamentals, and many vegetables. A sampling of these many hosts includes: Allium cepa (onion), Anemone nemorosa (European wood anemone), Antirrhinum majus (snapdragon), Arachis hypogaea (peanut), Beta vulgaris (garden beet), Boerhavia diffusa (a weed), Brassica oleracea (cabbage), Canna edulis (canna), Capsicum annuum (pepper), Citrus spp., Cucurbita pepo (pumpkin), Cynara scolymus (globe artichoke), Daucus carota (carrot), Dianthus caryophyllus (carnation), Dolichos lablab (hyacinth bean), Eucalyptus spp. (eucalyptus), Fragaria spp. (strawberries), Gerbera spp. (gerbera), Gladiolus hortulanus (gladiolus), Gossypium barbadense (cotton), Lactuca sativa (lettuce), Lycopersicon esculentum (tomato), Malus sylvestris (apple), Medicago sativa (alfalfa), Mentha spp. (mint), Morus spp. (mulberries), Nicotiana tabacum (tobacco), Oryza sativa (rice), Persea americana (avocado), Pisum sativum (pea), Pyrus communis (pear), Rheum rhabarbarum (rhubarb), Ricinus communis (castorbean), Rosa spp.



Spodoptera littoralis map prepared by USDA, APHIS, PPQ, Biological Assessment Support Staff

(rose), Rumex acetosa (garden sorrel), Salvia officinalis (sage), Solanum tuberosum (potato), Trifolium spp. (clover), Trifolium alexandrinum (berseem clover), Vitis spp. (grapes), Zea mays (corn), and Zinnia elegans (zinnia) (Paddock 1977, Hill 1975, Avidov 1969, Pearson 1958).

Characters

For many years this species was not recognized as distinct from S. litura. These two species are distinguishable only by their genetalia which must be removed, cleaned in alkali, and examined microscopically (Brown and Dewhurst 1975, Mochida 1973). The larvae are very variable in coloration and cannot be definitely separated. Adults of S. littoralis are also nearly identical in appearance to Spodoptera ornithogalli (Guenee), the yellowstriped armyworm, a common pest in the United States.

(Fig. 1)

Spodoptera littoralis adult female, dorsal view

ADULTS - Body whitish to yellowish, suffused with pale red. Hind wings of female darker than those of S. ornithogalli. Forewings yellowish with brown and white markings. Hind wings whitish with a narrow brown margin. Wing expanse 30-44 mm (Paddock 1977).

EGGS - Egg spheroidal, somewhat flattened, sculptured with approximately 40 longitudinal ribs, 0.4-1.0 mm diameter; pearly green, turning black. Covered with brown, hairlike scales from the body of the female (Pearson 1958).

LARVAE - Caterpillars in the 1st instar are pale green with black heads. Young larvae, first abdominal segment suffused with black pigment. Older larvae grey, brown, with dark markings or almost black, length 40-50 mm. Six instars with the later ones having black triangular spots on each side of each body segment and many black tubercles, each with a long black hair, yellow lateral and dorsal stripes (Paddock 1977, Anonymous 1968).

PUPAE - Dark red to reddish brown, enclosed inside rough earthen cases in the soil, 15-20 mm long (generally less than 30 mm) with the last abdominal segment terminating in two hooks (Hill 1975).

Characteristic Damage

Damage of S. littoralis is similar to S. litura which consists of feeding scars and skeletonizing caused by feeding on the undersides of the leaves. Initially there are numerous small feeding points which finally spread over the entire leaf. Later holes and bare sections are found on leaves, young stalks, bolls, and buds resulting from feeding activities of the pest. In certain cases the shoot tips above a hole wilt and eventually die (Anonymous 1968).

Physiological studies of the digestive mechanism of this insect revealed that under a regime of short food supply in the laboratory the caterpillars retain the chewed leaves in their intestines for a long period and fully utilize their nutrients. Under field conditions they consume amounts of food far in excess of their subsistence requirements and cause extensive damage to crops (Applebaum and others 1964).

Detection Notes

1. Spring through fall is the usual time for detection in temperate areas. S. littoralis may be detected any time the hosts are in a growing stage.

2. Check for 1st and 2nd instar larvae during the day on the undersurfaces of leaves of host plants.

3. Watch for skeletonized foliage and perforated leaves. If no larvae are obvious, look in nearby hiding places. Third instar and older larvae rest in upper soil layers during the day.

4. Net sweep for specimens at dawn or dusk.

5. Watch for external feeding damage to fruits.

6. Watch near lights and light trap collections for adult specimens.

7. Submit similar noctuid moths in any stage for identification (Paddock 1977).

Biology

The number of annual generations largely depends upon prevailing climatic conditions. Generally there are three in Spain and seven in Egypt. Adults fly actively during twilight hours and at night. In temperate areas during the summer they mate immediately after emergence and females begin to lay a few hours to 2 days later. At

other seasons of the year there is a preoviposition period of 2-11 days. Egg incubation lasts 2-3 days in summer, 3-6 days in spring and autumn, and 10-18 days in winter. Eggs are laid on the underside of leaves in batches of 100-300 and covered with hair scales; one female lays from 1,500-2,000 eggs. Hatching takes 2-6 days, but can take up to 26 days in cooler regions. Development takes 2-4 weeks through six instars.

Natural egg mortality levels are generally very low and a larva hatches from almost every fertilized egg. The young larvae feed in small groups on the undersurfaces of leaves. The first two larval instars are extremely sensitive to climatic conditions, especially combinations of high temperatures and low humidities. Most die at temperatures above 40°C. In May or September in Israel the young larvae die in large numbers after a severe warm southerly (khamsin) wind.

After the third molt the larvae scatter and live solitarily. During daylight hours they generally rest in upper soil layers; at evening they emerge from hiding places and climb the plants to feed throughout the night. Generally, there are six larval instars. In the hot summer months in Israel larval development lasts 12-18 days, while at lower temperatures development is slower and takes 20-30 days in spring and autumn and 70-85 in winter. Mortality levels are highest among the larval instars and most larvae fail to complete development. The larvae pupate in cells in the ground. Pupal development lasts 5-10 days in summer, 14-19 days in spring and autumn, and 21-31 days in winter. The natural mortality level of the pupae is also high, especially in winter.

Development is favored by a warm but not excessively hot climate. In the wet tropics breeding is continuous with up to eight generations per year, the life cycle taking 24-25 days. In temperate areas, complete development of a generation lasts 24-28 days in summer, 35-55 days in spring and autumn, and 102-117 days in winter, according to the temperature. Below 10.5°C development ceases. For the development of one generation 392 degree days are required (Bodenheimer 1951). Besides temperature, the nature of the host plant is also capable of affecting the length of development, though to a much lesser extent (Nasr and Ibrahim 1965).

In northern Egypt, breeding is continuous. There are seven generations a year, four of which occur on berseem clover (Trifolium alexandrinum) and span the autumn to spring period, during which the life cycle is prolonged. The two succeeding broods (5 and 6) are largest and occur on cotton in June and July, while the small seventh brood is found on both host plants in autumn. High proportions of the later generations each year are destroyed by bacterial disease. The larvae are voracious eaters and largely nocturnal (Anonymous 1968). The caterpillars skeletonize leaves. Later they devour leaves completely and mine their way into the young shoots. The pupa forms just below soil surface in an earthen cell. The unique importance of S. littoralis on cotton in Egypt may be due to large populations bred earlier on berseem clover being forced on cotton which is the only widely available food plant in the summer months.

During all stages after egg hatch the Egyptian cottonworm has a very high natural mortality. In laboratory rearings, for example, mortality reached 84.2-99.5 percent; that is, from every 1,000 eggs laid, 158 insects reached the adult stage under optimum conditions and only 5 under unfavorable conditions. In nature, conditions for reproduction are less favorable and mortality is higher. In Israel, the highest reproduction takes place in midsummer. By August it is already considerably reduced, and in autumn with the first rains and falling temperatures, reproduction suddenly drops. In autumn and winter, natural mortality is nearly 100 percent which would explain the abrupt disappearance of this species in autumn. When the autumn weather remains mild and the first rains are delayed the larvae continue to cause heavy damage until early winter. The most favorable conditions for reproduction of the moth and consequent plant damage are summers when prevailing temperatures are not too high (especially in August), the absence of khamsin weather in September, relatively high temperatures in autumn, and delay of the first rains.

Adults do not live long. In summer the females live 2-7 days, and during this short period they lay their eggs; in spring and autumn they live 3-11 days, and in winter 10-22 days. In all seasons of the year male longevity is shorter than that of the female. For the purpose of oviposition, the females prefer irrigated plants to nonirrigated ones (Avidov 1969).

Natural Enemies

Parasites: Euplectrus spp. especially E. laphygmae Ferrier (a eulophid wasp) in Israel (Gerling and Limon 1976); braconids Apanteles risbeci DeSaeger in Senegal, Bracon hebetor Say in Israel, Chelonus curvimaculatus (Cam.) in South Africa, C. inanitus (Linnaeus) in Israel and Egypt, C. submuticus Wesmael in Israel, Microplitis rufiventris Kokujev in Egypt, Israel, and USSR (Turkestan), Zele chlorophthalmus (Spinola) and Z. nigricornis Walker in Egypt; ichneumonids Barylypa humeralis Brauns in Egypt, Eulimnerium xanthostoma (Gravenhorst) in Egypt, Hyposoter didymator (Thunberg) in Israel; trichogrammatids Trichogramma evanescens Westwood and T. minutum Riley in Egypt; a chalcidid Conomorium patulum (Walker) in Egypt; a scelionid Telenomus remus Nixon in Israel; and tachinids Actia palpalis (Rondani), Exorista larvarum (Linnaeus), Peribaea orbata (Wiedmann), Tachina larvarum Linnaeus, and Tachina sp. in Egypt (Hegazi, Hammad, and El-Minshawy 1977, Hafez and others 1976).

Predators: In Israel, predacious mites Amblyseius chilenensis Dosse, A. hibisci Chant, Agistemus exsertus Gonzalez (Swirski, Amitai, and Dorzia 1970), and Typhlodromus occidentalis Nesbitt (Swirski and Dorzia 1969); in Egypt, anthocorid bugs Blaptostethus piceus Fieber var. pallescens Poppius (Tawfik and El-Husseini 1972) and Orius albidipennis (Reuter) (Tawfik, Abul-Nasr, and Saad 1974), lady beetles Coccinella undecimpunctata Reiche (Afify and Farghaly 1971) and Scymnus interruptus Goeze (Tawfik, Abul-Nasr, and Saad 1974); earwigs Labidura riparia Pallas (Afify and Farghaly 1971), and Euborellia annulipes (Lucas) (El-Husseini and Tawfik 1972); and a rove-beetle Paederus alfierii Koch (Tawfik, El-Sherif, and Abouzied 1976).

Other agents: Rodriguez-Rueda and Fargues (1980) have carried out experiments in France that show the fungi Nomuraea rileyi (Farlow) Samson and Paecilomyces fumoso-roseus (Wize) A. M. S. Brown and G. Smith are effective in destroying the eggs of S. litura, opening a promising area of biological control. A nematode Neoaplectana carpocapsae Weiser seems to be another promising control agent in Egypt (Sikora, Salem, and Klingauf 1979). In Egypt, research is underway to learn more about the use of nuclear polyhedrosis viruses as control agents (Nasr and Elnagar 1980).

In Israel, epizootics caused by a nuclear polyhedrosis virus destroy entire caterpillar populations of the pest. This mostly occurs late in the season when populations are already densely crowded and the lower temperatures of the autumn nights act as additional stressor in activating the virus which is latent in more than 80 percent of the larvae in the field. Caterpillars orally contract the disease by ingesting food contaminated with the polyhedral inclusion bodies of the virus. Death occurs after activation of the virus within 9 days in summer or 13 days in autumn. Feeding activity becomes increasingly reduced 48 hours after activation, and it stops altogether by the 4th day.

All larval instars are susceptible to infection by the virus. If inoculated when about to pupate, larvae subsequently die as pupae. But, when a sublethal viral dose is administered into the caterpillars, the pupae will develop into adults; which will either be reproductively sterile or produce mostly nonviable eggs. When such eggs were seen to hatch, the neonate larvae died shortly as a result of the congenital nuclear polyhedrosis virus. Thus the virus is transmissible from generation to generation; female moths carrying the virus in a latent form are able to pass it to their offspring through the eggs. Methods have been developed for mass rearing of these insects and infection of caterpillars on an artificial medium for extraction of the virus from the cadavers for use as viral control agent against the Egyptian cottonworm in the field (Avidov 1969).

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